

Technology Opportunity

Neural Network Based Sensor Validation

The NASA Glenn Research Center is actively developing neural network based Sensor Fault Detection, Isolation, and Accommodation (SFDIA) technologies which have been simulated and tested in various aircraft components.

Potential Commercial Uses

Sensor Fault Detection, Isolation and Accommodation (SFDIA) techniques can be used in various systems that require continuous health-condition monitoring of the system in order to achieve high productivity and to avoid unnecessary system shut-down. Potential applications include the operation of aircraft engines, automobiles, chemical plants, and other automated tasks.

Benefits

- Improves the system operability
- Extends the useful life of the system
- Minimizes maintenance and maximizes performance

The Technology

In order to ensure reliable operation and to improve measurement accuracy, a complex dynamic system usually uses redundant sensors for measuring critical variables. In many cases, the analytical sensor redundancy is implemented to achieve the measurement goal without physical redundancy. This analytical redundancy makes it possible to validate measured data, to identify a sensor failure, and to recover the failed measurement. This can be accomplished by using an auto-associative neural network.

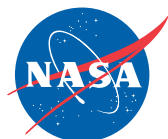
An auto-associative network is trained to produce an output vector that is equal to its original input vectors. The operation of the auto-associative network is based on the principle of dimension reduction. The input information is compressed by a

process of dimension reduction, before it is regenerated to recover the original information. The redundant sensor information is compressed, mixed, and reorganized in the first part of the network. In the compression process, the sensor information is encoded into a significantly smaller representation. The compressed information is then used to regenerate the original redundant data at the output. Because of the information mixture, if a sensor fails, other redundant sensor data can still provide enough information to regenerate a good estimate for the faulty measurement. Because of its parallel-processing capability, the neural network can process real-time data for time-critical applications. Also, because it learns by example, the neural network does not require a detailed system model for sensor validation as is often required.

After the training, the neural network can be implemented in a closed-loop configuration to validate the control sensors for system performance purpose. During operation, if a sensor signal is significantly different from the corresponding estimated value, the sensor signal is considered incorrect and a failed sensor is identified. The failed sensor reading is isolated by feeding the neural network its previous estimated value. The isolation of a failed sensor enables the neural network to detect subsequent sensor failures.

Options for Commercialization

One of NASA's missions is to commercialize its technology. The NASA Glenn Research Center's goal is to commercialize its neural network based sensor validation techniques described herein. The commercialization of these techniques can be in the form of software package or hardware implementation. Any company wishing to license these fault detection techniques may do so provided it has a sound business plan with a high potential for success.



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Key Words

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